

Surface and Atmosphere Geochemical Explorer



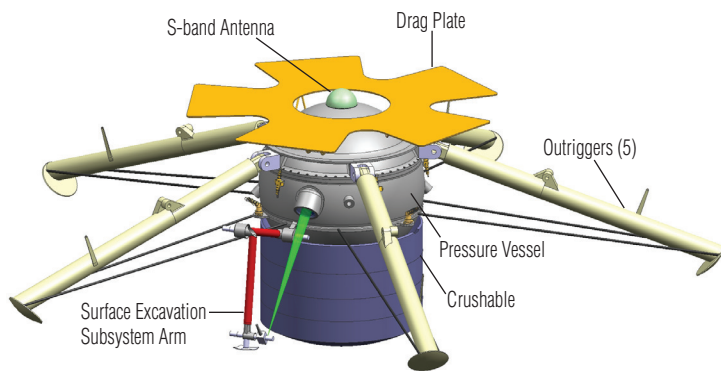
The Surface and Atmosphere Geochemical Explorer (SAGE) studies the history of the atmosphere, climate, and surface of Venus, comparing it to Earth and to extrasolar planets. SAGE tells us about the history of Venus, why it is so different from Earth, and what this can tell us about Earth's fate. SAGE informs us about extrasolar planets discovered by Kepler and other surveys. Descending through the thick, toxic Venus atmosphere for an hour, the Lander touches down on the flank of a possibly active volcano, Mielikki Mons. There, it conducts a 3-hour surface mission, where the pressure is like being a kilometer deep beneath Earth's ocean and the temperature is hot enough to liquefy lead.

Mission at a Glance

- Launch—December 2016, 21-day launch period
- Trajectory—short duration, flyby, 136 days maximum
- Separation—April 2017, 5 days before descent
- Descent—May 2017, 1 hour
- Landing site: Mielikki Mons
- Surface science: 3 or more hours

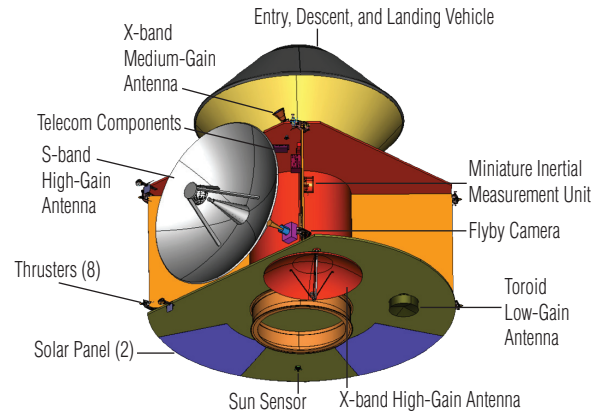
Objective/Instrument	Measurements	Provider
Atmospheric Dynamics		
• Flyby Camera (FBC)	• Ultraviolet and near-infrared imaging for entry context and cloud dynamics	• Space Research Institute of the Russian Academy of Sciences
• Atmospheric Structure Investigation (ASI)	• Temperature, pressure, dynamics, and wind speed	• NASA Ames Research Center
Atmospheric Composition		
• Tunable Laser Spectrometer (TLS)	• Stable isotope ratios	• Jet Propulsion Laboratory, California Institute of Technology
• Neutral Mass Spectrometer (NMS)	• Major, trace, and noble gas species	• NASA Goddard Space Flight Center
Surface Geology and Weathering		
• Descent and Panoramic Cameras (DPC)	• Descent and surface imaging	• Malin Space Science Systems
• Microscopic Camera	• Imaging of Raman/LIBS site	• Malin Space Science Systems
Surface Composition and Mineralogy		
• Neutron-Activated Gamma-Ray Spectrometer (NAGRS)	• Major, minor, and trace surface and subsurface elements	• Space Research Institute of the Russian Academy of Sciences
• Raman and Laser-Induced Breakdown Spectroscopy (LIBS)	• Surface and subsurface minerals and elements	• Los Alamos National Laboratory

SAGE Spacecraft Lander and Carrier



Lander

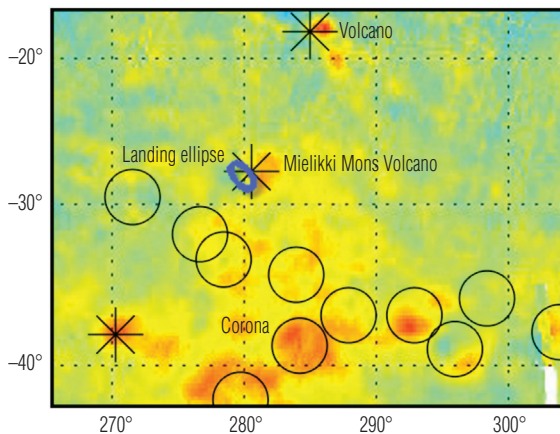
- Atmospheric measurements to the surface
- First-time nested descent images
- Active and passive analysis of the surface and subsurface
- Standard temperature and pressure on the surface within the Lander pressure vessel
- Environmental testing verifies Venus surface operations



Carrier

- Mars Reconnaissance Orbiter (MRO) and Gravity Recovery and Interior Laboratory (GRAIL) heritage and design commonality hardware and software, including fault protection
- Compatible with Atlas V and Delta IV launch vehicles
- Three-axis stabilized with coupled thrusters
- Receives, stores, and retransmits science observations
- X-band Earth downlink uses only 34-meter Deep Space Network antennas
- S-band link between Lander and Carrier for reliable data transmission

SAGE Landing Site



The SAGE landing site is on the flank of one of Venus's many volcanoes. High-emissivity regions (red) are interpreted to be areas where lava flows are relatively recent. Image courtesy VIRTIS, Venus Express, European Space Agency.

SAGE Team

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- Laboratory for Atmospheric and Space Physics, University of Colorado at Boulder—Science Leadership, Science Data Archive, Education and Public Outreach
- Jet Propulsion Laboratory, California Institute of Technology—Project Management, Project Systems Engineering, Mission Management, Lander, Entry-Descent-Landing
- Lockheed Martin—Carrier, Entry and Extraction Subsystem, Integrated Flight System Assembly, Test, and Launch Operations
- NASA Ames Research Center and NASA Langley Research Center—Technical support for Venus atmospheric entry and descent
- Canadian Space Agency and MacDonald, Dettwiler and Associates Inc.—Surface Excavation Subsystem
- Centre National d'Etudes Spatiales and Centre d'Etudes Spatiale des Rayonnements—Lasers for Raman/LIBS Instrument

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For more information about SAGE, go to:

<http://sagemission.jpl.nasa.gov/>